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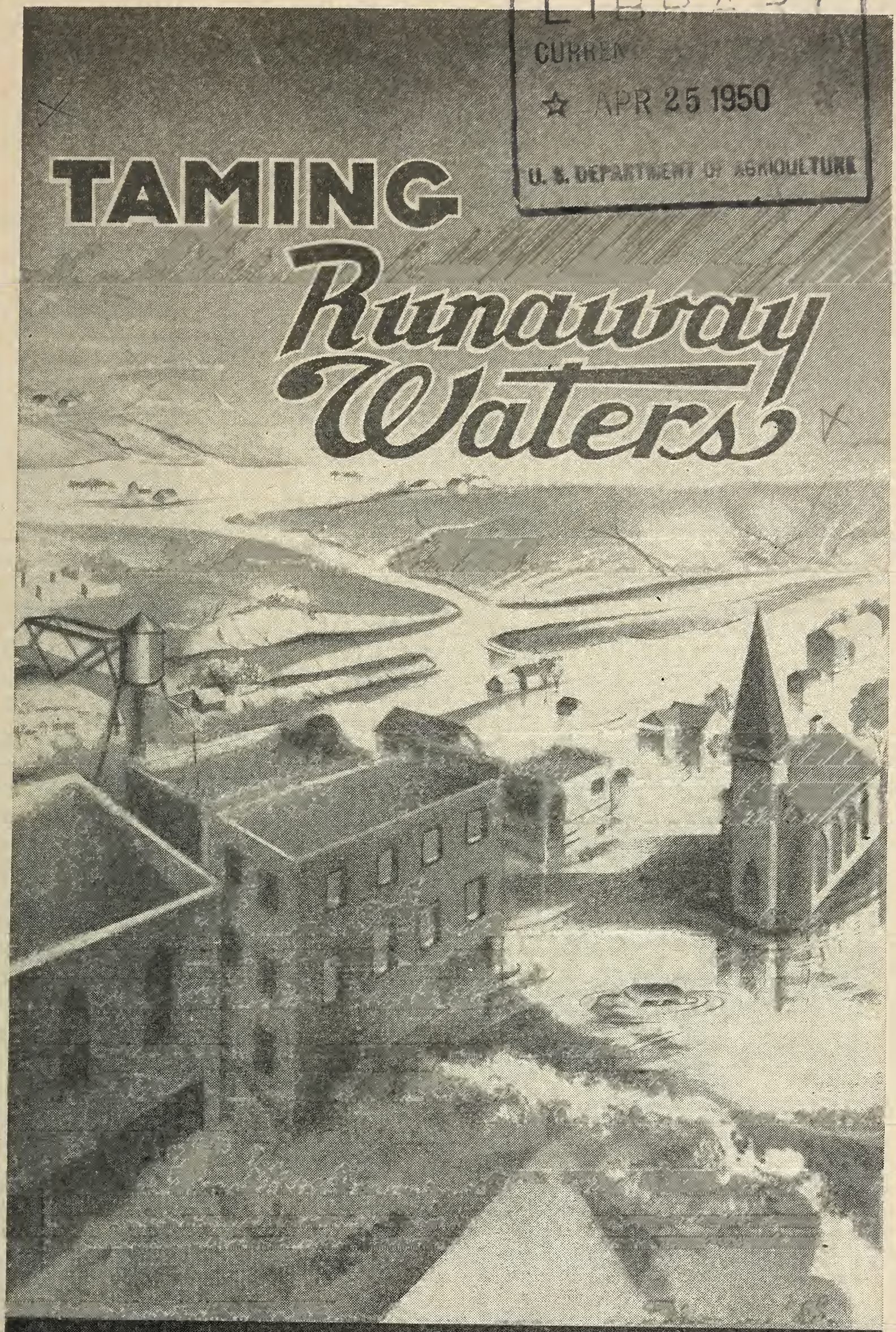
U. S. DEPARTMENT OF AGRICULTURE

TAMING Runaway Waters



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

AIS–85

By C. W. Gee, *Information Specialist, Upper Mississippi Region, Soil Conservation Service*

Perhaps you regard floods as calamities which have no effect on you personally. Noah also may have had the same idea about floods. Like many of us, he probably thought nature visited them upon others who were foolish enough to build their homes in lowlands along the river. However, Noah later saw the light and became the World's No. 1 shipbuilder.

You may not live in a house by the side of the Mississippi. You may not be interested in the power or navigation

business. You may not even like to fish and hunt.

But, whether you are a farmer or a city man, floods directly affect you. Because you eat, drink water, use electricity, and pay taxes, whoever you are. They are injuring you even though you have built your house on the highest hill.

Floods are common. For that reason, you and other newspaper readers are pretty familiar with the subject.

If radio's "man on the street" who interviews passing citizens were to stop you some day and ask about floods, it might sound like this:

Announcer: Mr. Smith, our question today is what can be done to stop floods which cover the Mississippi and other major river valleys so often, drowning people and livestock and damaging both public and private property. What do you think should be done about this problem?

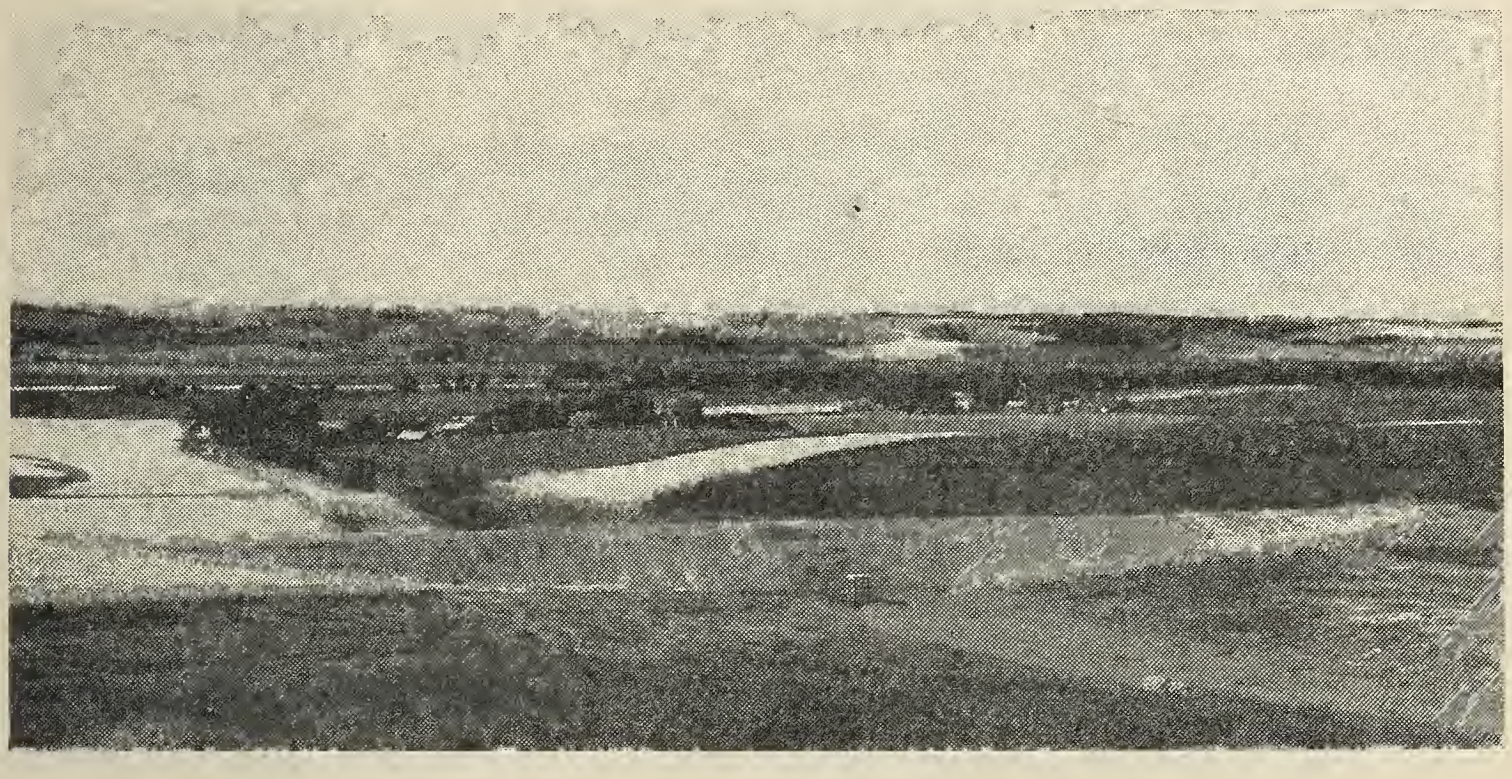
You: Well, I think the Government is building reservoirs to hold back floods and building levees along the bigger rivers. I guess that's the best thing that can be done.

Both you and the announcer were considering only part of the flood problem.

You were talking about the floods that sweep down the Missouri, the Columbia, the Ohio, and other large rivers. These floods are spectacular. They make the newspaper headlines all over the country. Actually, however, they cause only 25 percent of the Nation's total losses due to floodwaters. The best available estimates show that 75 percent of our annual damage from overflow and sediment is caused by floods in the smaller headwater valleys. But this damage seldom gets more than local attention.

When rivers in the upper Mississippi Valley States broke out of their banks in 1947, the Soil Conservation Service was asked to make a flood survey. This survey showed that in the three States, Iowa, Illinois, and Missouri, the 1947

This before view shows the site of the first soil-saving structure built on the Little Sioux watershed. The drop-inlet dam, shown below, cured this gully which was on the Nepper farm near Mapleton, Iowa. Such dams slow excess run-off water.



flood damage to agriculture was 153 million dollars. Furthermore, the storm which caused this flood washed away nearly 500 million tons of topsoil—not included in this estimate—from the rich fields of the Corn Belt.

This topsoil represents food for you. It represents dollars and cents to the farmer, for his land is worth much less money per acre when topsoil is gone. If the soil lost from the farms of these three States in 1 month were valued at only $1 per ton, then the agricultural damage done by this storm and resulting flood would stand at approximately 644 million dollars. The flood damage to towns and cities was estimated at only $17,415,000.

Let's assume you do not live on the headwaters of the Mississippi and are safe from overflow on any other watershed. You're a city man.

Unfortunately for you as a city water consumer, the topsoil which washes from the farms around your town does not all float hurriedly down the river until it reaches the ocean. If your city has a reservoir some of it settles there.

If you are one of more than 75 million

American citizens who drink water that comes from surface streams, the chances are your city used a lot of chemicals to remove all the impurities. It's treated because your stream is polluted, particularly with sediment of flood origin. And, you're paying local taxes to purify what you drink.

However, you might be even more interested in knowing that sediment and

pollution are also stealing your capital investment. After all, your reservoir was built with tax money and you own an interest in it.

Your reservoir was originally designed to hold a specified quantity of water—enough to supply your city in even the driest year. But today it probably holds much less water than you think. Ask your waterworks superintendent if he has made a survey to find out just how much storage is left. Scores of American cities have been astonished by the results of such surveys.

Decatur, Ill., is a good example. Taxpayers of that city built their reservoir in 1922. By 1946 sediment had already filled 26.2 percent of the original water-storage space. Their investment is being gradually wiped out, year by year. Decatur now faces the threat of a water shortage before the present decade ends, although the reservoir would have served all city needs until the year 2000 but for silting. Fortunately, this city is able to take steps to supplement its water supply.

This is one reservoir. You and other city people of the United States have invested a big part of the 5 billion dollars spent in building approximately 8,900 of the Nation's larger reservoirs. Sediment, most of it carried by floodwaters, is steadily wiping out your multi-billion-dollar investment to the tune of an estimated 50 million dollars annually.

There are many other reasons why floods are your personal problem.

Electricity is handmaiden in your home. It toasts your bread, washes your clothing, and performs many other household chores. But even electricity is not immune to floods. For America gets one third of its electricity from water power. And like your city lake, power reservoirs are frequently the victims of sedimentation. A survey of power reservoirs in only four Southeastern States during one dry summer recently showed a loss of approximately 90 million kilowatt-hours due to sediment which had reduced reserve storage space. In the rates you pay, this represented a loss of $1,600,000 in these four States during a single season.

You yourself may not own any electric company stock and may not share in the loss from depleted reservoirs or the cost of building new ones. But such costs are a part of the company's legitimate operating expenses and are considered in establishing the rate you pay for electricity.

Again you are "low man on the totem pole" when floods wipe out thousands of acres of corn in Iowa, Illinois, and other Corn Belt States. You own no cornland yourself but you eat pork chops and the prime steak you enjoy comes from corn-

fed steers. Certainly, a short corn crop is reflected in higher prices on beef and pork.

But power, light, water, even the food you eat are not your only items which carry a price tag set in part by floods.

So far, your country has spent an estimated $3,200,000,000 on waterway improvements such as dredging, improving channels, and building levees. We Amer-

icans were spending an estimated $11,000,000 every year before the late war in removing new sediment and keeping these inland waterways and harbors open to traffic. Each year we dredge out two-thirds as much earth as we moved in constructing the entire Panama Canal.

Why does this concern you personally? You're a taxpayer and tax money pays the bill.

No one knows for certain how large the Nation's annual bill might be for both main valley floods and headwater floods. Estimates range from 100 million dollars to several times that amount.

Dr. Hugh H. Bennett, chief of the Soil Conservation Service, is authority for this statement: "The cost of our annual erosion damage will easily exceed a billion dollars in measurable physical damages alone."

Your share in this loss, if you pay the bills for your wife and only one child, would be approximately $20 each year, whether you live on a hilltop or in the valley.

But perhaps you don't live in the city. Perhaps you're a farmer. Let's see how floods are hurting your pocketbook.

You and your family pay a larger share of the national erosion bill than your city cousin. You also pay your part of the Federal income tax from which come the millions spent in keeping our rivers and harbors open.

Both you and your city relative like to fish. Probably both of you remember when the shallow, muddy creek which now harbors a few carp and bullheads used to be a fine bass stream. Its waters were clear then, and 5-pound beauties lurked in the deep holes.

But those days are gone. Where clear springs from wooded hillsides and pasture land fed the creek in the old days, muddy water now pours into it during spring freshets from fields of corn cultivated up

This series of pictures shows how soil lost from a straight row cornfield can blight bottom-land crops or become mud bars which clog the river channels and other waterways.

and down the hill. Flood-borne waters filled the creek with sediment which has spoiled your fishing.

If you are a bottom-land farmer living in a valley on the headwaters of the Mississippi you may remember when that swampy meadow bordering the creek was one of your best fields. As the little stream gradually filled up with sediment, the water level rose higher and higher. Water seeks its own level. Small wonder the adjacent field has become swampy.

Or perhaps your trouble is not swamping. It may be that the creek now overflows your land. Its channel is half full of soil and cannot carry away as much water as it handled 25 years ago.

Perhaps you live on the Missouri flood plain and have spent thousands of dollars during the last 25 years trying to keep your drainage ditches open. It's fruitless as long as flash floods continue to carry down soil out of the hills. You are equally helpless if your land is gradually being scoured away by floodwaters or covered with gravel and subsoil. Thousands of acres of once fertile bottom land such as this are now covered several feet deep by flood debris. And the acreage of land thus damaged is increasing.

But you may not be a farmer of the valley lands. Yours may be an upland farm which neither overflows nor swamps. In that case, your farm may be the troublemaker for your bottom-land neighbors and the public generally if you haven't applied conservation measures.

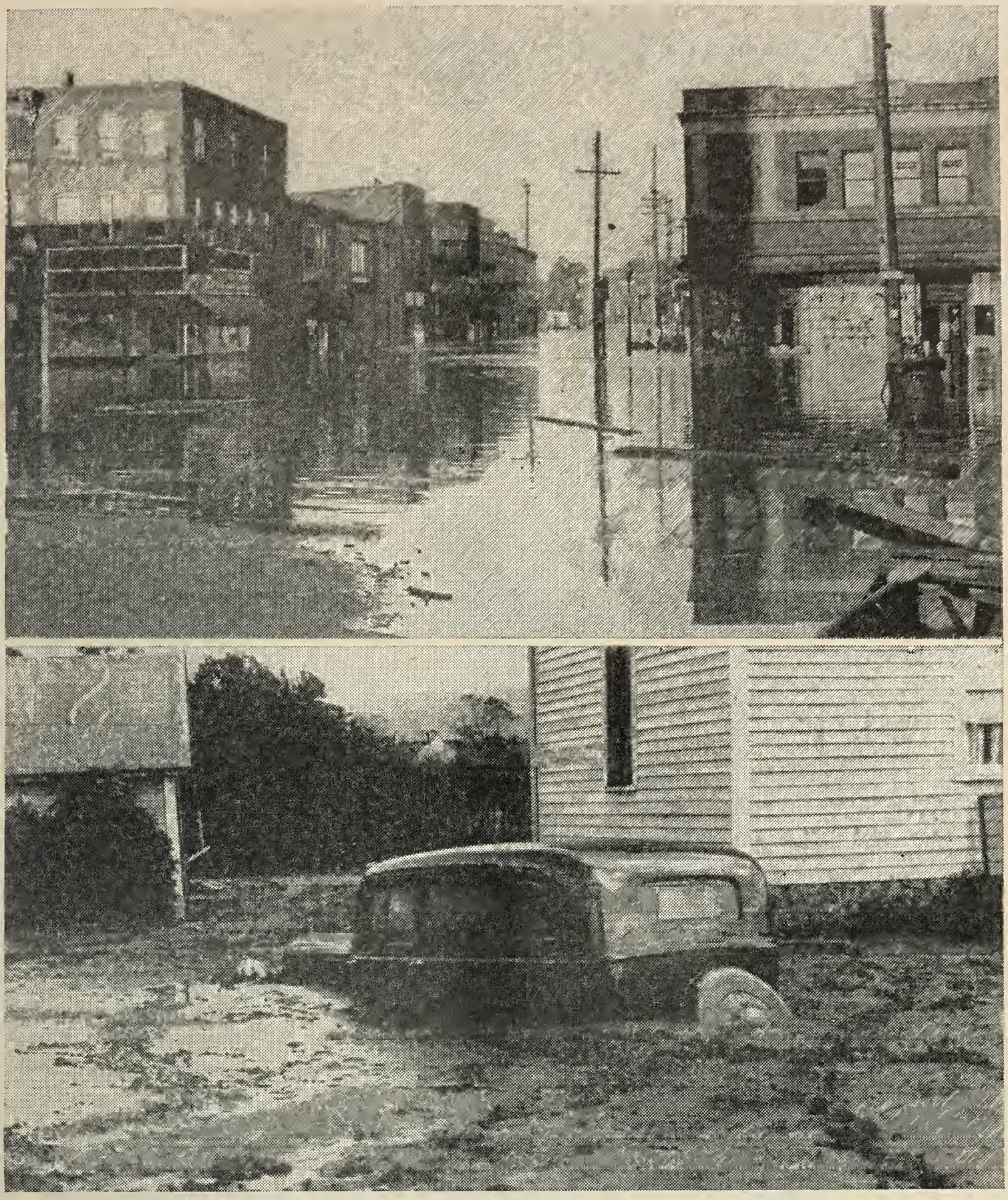
Each rain which causes excess runoff from your unprotected, sloping fields adds to the Nation's flood damages. Each downpour is carrying away many times more plant nutrients than you use in growing crops. The moisture you need for growing corn is flooding your neighbor's bottom land.

The gully which is gradually cutting your best upland field in half is stealing your soil every time a hard rain falls, dumping it down on the bottoms, filling drainage ditches, clogging watercourses and forcing the taxpayers to dredge it out and build higher levees down in the cotton country.

For when your topsoil leaves it becomes a liability to you and to your Nation. It doesn't grow corn any more because it has become a statistic listed nationally as "Flood damage."

You, your city cousin and all of America pay the bill.

Soil from this gully has reduced the water capacity of the streams below it.



The scene above at Ottumwa, Iowa, depicts how severe runoff from farm land affects lower urban areas. Below, flood debris buries a car in Minnesota.

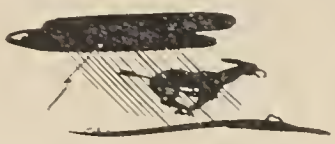
WHAT BREEDS FLOODS

As we have already explained, the flood-control problem is twofold. Steps must be taken to reduce headwater flood damage which is largely agricultural, and adequate measures must be applied to protect our huge capital investment from main-valley floods.

The great floods in the main valleys are caused by widespread rain covering much or all of a river's watershed, or perhaps by the rapid melting of deep snow on frozen ground. Usually, it is

not a driving rain which piles up inches on a local weather gage in a short period of time. Instead it is a steady downpour over a wide area which may continue for days until the soil is completely soaked and can take up no more moisture.

Many small streams over thousands of square miles pour water for days into



the main river valley from all sides. Eventually the river spills over and another main-valley flood makes headlines.

However, many of the damaging floods on small headwater streams are caused by short rains of high intensity which do not produce serious overflow in the larger, lower valleys. Such floods, with few exceptions, are caused by heavy spring and summer rains. Although these floods don't threaten the levees at Memphis, they do cause heavy damage because they usually occur during the growing season for crops. Some of the best farm land in the United States is found in these headwater valleys.

Men and their works have caused much of this local flood damage. They have

logged off forests without planting trees, torn up the native grasses which once blotted up rainfall on the hillsides and have put the land into cultivated crops.

They have increased runoff from these lands without providing adequate water-disposal systems to handle it or slow it down.

Today, floods and flood damage have become an intolerable burden to America's economic system. Whether it should remain so largely depends on whether man is willing to compensate for his use of the land by adequate control measures.

YESTERDAY'S PIECEMEAL APPROACH

By this time you are probably wondering what the people and their Government have been doing about floods during the past few generations and why the millions of dollars already invested haven't solved the problem.

It is true, notable results have been achieved in some main valleys such as the lower Mississippi. But our national flood damage is still far too great. Our principal shortcoming has been a piecemeal approach to the flood problem. There has been too little coordination and not enough consideration of how one set of flood-control measures might affect conditions in another part of the same river basin.

True, reservoirs have been built which in some cases have irrigation, power and recreational possibilities, in addition to flood-control benefits. Yet in very few places has good land use and treatment been applied on the watersheds of such reservoirs to reduce the sediment flowing into them.

Channels have been straightened and deepened locally with good results for the time being. Levees have paid their way by preventing larger rivers from overflowing in most years, thereby saving thousands of acres of crops.

But our approach to controlling flood damage in headwater valleys has been very limited and scattered, even though such a control program would not only attack our most costly flood problem at the source, but would also add to the life of improvements made downstream.

Valuable work has been done by individual farmers, by watershed associations and by municipalities to develop better water-disposal systems on the headwaters and to control sediment. But such work has lacked coordination over large areas.

Conservation farmers make greater profits

A study of income figures from 1,872 farms in 23 States shows 984 conservation farmers grossed $7,332 per farm whereas 888 nonconservation farmers grossed only $5,950. Conservation farming added $5 an acre a year for the 984 farms. Yields are taken from a 1947 study in Ohio.

A NEW LOOK AT FLOOD CONTROL

Years ago, lack of understanding hampered a fully effective approach to flood control. But by 1936 public thinking had advanced to the point where Congress passed the Omnibus Flood Control Act—a measure which has gone far toward overcoming this obstacle. It gave the Secretary of Agriculture his first authority to investigate headwater floods to determine what effect soil conservation and reforestation, including adequate water-disposal and channel-stabilization measures, might have on runoff and sediment production.

The Soil Conservation Service and Forest Service were designated by the Secretary as the Department's two agencies to carry out its new responsibilities under this Act.

They sought the answers to two major questions. Here are the questions and the answers they found.

Q. Will forest, range, and farm-land conservation treatment of watersheds reduce flood damage?

A. Yes, materially. But in localities where steep slopes or bare denuded areas have caused extreme runoff and large deep gullies, improvement in land use alone is not enough. It must be accompanied by such mechanical devices as debris basins, soil-saving dams and flood-water-retarding structures as a part of stabilized and permanent water-disposal systems.

Q. Will the benefits from such a program be greater than the costs?

A. Yes, in most cases. Because this work not only reduces flood damages but also saves soil and increases farm income materially.

We know now that soil conservation, reforestation, and other watershed-treatment measures are the most effective methods of reducing headwater flood damage, this being principally agricultural. But such a program alone is not enough to give the protection needed against main-valley flood crests. Because these, you will remember, are caused by long, steady rains, or fast-melting deep snow over a wide area. Reservoirs, levees, and improvement of major channels are essential in controlling main-valley floods.

Soil conservation on the headwaters makes a valuable contribution, however, to flood control in the main valleys. By reducing sediment carried into the main valleys, it can prolong the useful life of downstream flood-control reservoirs. It can also protect main-valley farms from being buried under flood debris from the uplands.

There have been floods since Noah's day and no man of wisdom would ever predict that floods can be completely eliminated. However, all but the worst floods can be controlled and the Nation's annual flood damage can be cut to a fraction of its present huge total. And these things can be done by the new coordinated approach which is conservation treatment of watershed lands and minor waterways combined with reservoirs and other necessary main-channel improvements downstream.

JOINING FORCES ON THE HEADWATER

Although this more enlightened trend in our national thinking is still relatively new, the Department of Agriculture is already in action. In 1944 Congress authorized watershed-treatment programs on 11 watersheds in various parts of the United States. By 1947 the first such work in the central United States was starting on the Little Sioux River of northwestern Iowa, a tributary of the Missouri.

You may wonder whether this is an instance of the Federal Government moving into a local area, condemning private property and mandatorily imposing a program of controls. We assure you, this is not correct. In it, everyone, including local, State and Federal Governments has a part. And the most important part of all is played by the farmer himself.

The headwater program on the Little Sioux consists of both land treatment and gully control. This treatment involves

a broad soil conservation program on the farm land which will retard runoff and control soil erosion. Better crop rotations, grass waterways, winter cover crops, contour farming, and terracing are among the key methods.

The program is purely voluntary on the part of the individual farmer and is organized and directed by farmers and local people. The success of the land-treatment phase rests almost exclusively with the landowner.

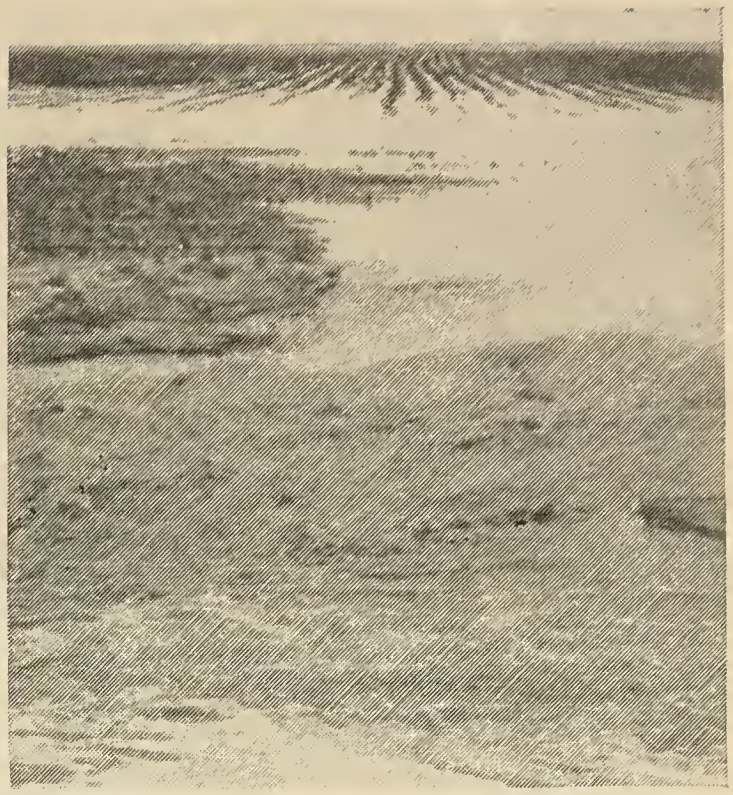
His part in the headwater phase begins with developing a soil- and water-conserving program on his own farm. However, the structures and other flood-control improvements on his land which the Federal Government assists him in building, also give him some degree of benefit. Therefore, with the benefits he also has certain responsibilities in maintaining these structures.

Federal money cannot be spent on such improvements until the individual landowner and his neighbors agree to the work and grant right-of-way to the local soil conservation district for construction and future maintenance.

The watershed farmer is truly a pivot man on the headwater flood-control team but he does not work as one lone individual nor does he receive Federal assistance as such. His contribution is made as a member of the group which includes all of his neighbors owning farms that drain into the same minor watershed. Runoff water does not recognize fence lines and what one farmer does or fails to do has a direct influence on the entire group.

Because flood control and soil erosion are not individual problems, Federal assistance in headwater programs is given to watershed groups. This is the most effective approach.

When farmers of an entire minor



Above, water from sloping field carries away topsoil. At center terrace holds water on field during spring rain. Below, terrace helps to hold moisture on land even in winter.

watershed work together to solve their problems, Federal assistance can be given them much more effectively. By the same token, the program can be more speedily applied on the land.

However, an even more comprehensive working organization than minor watershed groups is needed to insure well-coordinated local participation. The soil conservation district, an independent democratic organization of farmers within a county, or covering several counties, meets this need. In the case of the Little Sioux, this broader organization has proved an effective working unit. It is a tool already at hand in many areas needing flood control.

In the Little Sioux area, 12 soil conservation districts which blanket the entire lower watershed, agreed to band together into an even larger working organization. Representatives were chosen from each district to form a watershed work committee which represents the entire 2,700 square-mile lower drainage area.

These districts determine the priority with which minor watersheds should be scheduled for this cooperative work with the Federal Government. They also obtain easements and rights-of-way from individual farmers and have responsibility for working out a program of maintenance. For this purpose farmers and others contribute to their own district maintenance fund rather than to the Federal Government.

Both State and local governments also take an important part in a headwater program. During the early stages, representatives of the Department of Agriculture are actively assisted in assembling survey information by such State agencies as the Extension Service, water- or soil-resource commissions, State soil conservation committees, State experiment stations, and others.

County governments, too, are members of the flood-control team and help in the engineering work. Where flood-control structures are needed on either county or State highways, the State or county, whichever the case may be, actively cooperates. They assist in construction of flood-control measures affecting the highway system and assume the expense of future maintenance. In some cases counties have shared in the cost of the concrete structures, being well aware that the proposed improvement will permanently benefit the county road system

Building the forms for a new drop-inlet dam at the lower end of the Nepper.

Terraces, above, and contour cultivation both hold more water on the land.

TREATING THE WATERSHED

In developing a watershed program the Department first makes a survey to determine whether such a program would be effective and whether the benefits would be greater than the costs. If so, it submits a favorable report to Congress. If Congress authorizes a program for the watershed and appropriates funds, work begins.

Under the new approach to flood control, everything the Department does is closely coordinated with main-channel work carried out by the Department of the Army, Corps of Engineers.

On the Little Sioux, both the Department and the Engineers exchanged

information during the survey stage. In planning for main-channel improvement, levees and desilting basins, the Corps of Engineers had access to information revealed by the Department's survey of the upper watershed. They knew that a soil conservation and a gully-control program would reduce runoff from 5 to

37 percent depending upon the locality, the intensity and duration of the rain, soil conditions and other factors; that the program would reduce the amount of sediment from erosion an average of 55 percent. This information was considered in main-channel engineering.

We will give you only the highlights of how the program to retard runoff and control soil erosion on the Little Sioux is being carried out.

As to the land-treatment phase of the work, the Soil Conservation Service furnishes the technical men needed to help farmers carry out soil- and water-conservation practices on a watershed basis. These technicians work through the soil conservation districts. Engineers, in both the regional and field headquarters of the Service, plan and design the water-disposal measures to control runoff and stabilize gullies.

The Service also handles funds and

awards contracts for the actual construction on a competitive-bid basis. All construction is done by private contractors. The Service also maintains constant inspection while construction is underway to see that standards of quality are being met.

The rest of the program must be carried on by farmers and local people.

PUBLIC DIVIDENDS

The Nation's annual flood loss has been slowly increasing for the last 100 years. Millions of farmers have unwittingly contributed to it. Many good farmers in their day have worked the soil to the best of their ability and according to the general practices others were then following. But this was in an era when a farmer could get little reliable information on his erosion and flood problems.

Overgrazing of the western range lands has increased today's flood problem and so has the exploitation of the forests with which nature endowed North America. But here again our present-day tendency to censure these pioneer operations must be seasoned with moderation. For less was known in that day about either

modern range-management methods or selective logging.

In view of the fact that a century of intensive land use gradually produced the present-day flood problem, we cannot expect it to be solved overnight, particularly as it affects so many millions of us. However, progress now is being made.

As the Department gained experience in dealing with smaller watersheds it became increasingly apparent that a sound program could be more effectively developed from large area studies. For that reason the problem is being approached on a basin-wide rather than piecemeal basis. Such a basin might be the Missouri or Rio Grande, made up of a myriad of subwatersheds ranging from 500 to 5,000 acres or more.

This broadened approach to flood control is still new. For that reason, the day when actual results can be cited for sizable watersheds is not yet here. How-

Grass legume pastures boost farm income while improving use of the soil.

Grass waterways, center, and winter cover crops, lower, both aid flood control.

ever, from past experience and past studies, specialists of the Department of Agriculture are learning what goals they can expect to reach.

For the city man, this new program should mean an eventual reduction in costs of government and less flood damage to his home and other lowland property. It should mean a safer and more certain water supply, perhaps cheaper power rates, a more nourishing and more plentiful supply of foodstuffs at the corner grocery.

For private industry the benefits forecast by such a program are unmistakable. There should be lower maintenance costs on such industrial necessities as power and water, not to mention more assurance of an adequate supply. And for our heavy industry, huddling along America's many inland waterways with a wary eye upstream, such a program means a substantial reduction in recurrent flood losses.

For the sportsmen it should mean better hunting, better fishing, and greater recreational facilities. The sportsman need not be a biologist to know that bare and denuded hillsides and hungry gullies do not produce good hunting. Nor are fine game fish found in streams polluted by silt and flood debris.

But to the farmer who suffers the heaviest part of the Nation's annual flood damages, the new approach to flood control offers even greater rewards.

Research has proved that losing only 1 inch of topsoil from a field reduces corn yields up to 6 bushels per acre. The farmer who has looked at his crops, still green on a terraced and contoured slope despite the drought, can easily see that soil conservation preserves more rainfall to grow crops for market.

Farmers by the thousands throughout the United States have been interviewed on this point. Every survey has proved that a soil and water conservation program consistently increases the cash farm income by boosting crop yields.

According to the best available estimates, the income of 500,000 farmers in this country had already been increased $250,000,000 annually by 1949. And this was accomplished by adopting a conservation system of farming which provided effective soil and water management.

Much of this quarter-billion-dollar increase in agricultural income went into the channels of trade, but a good deal of it went into the farmer's Federal income tax. So, by that token, American agriculture is lifting itself by its own bootstraps, paying income taxes to support the soil conservation program which is producing the increased income.

Unquestionably this new type of flood control holds promise not only of greatly reduced flood damages, but also of a more prosperous and permanent agriculture for this and future generations of Americans.

Issued November 1949.